CLAIMS

We claim:

sub a9

1. An inflatable heating device comprising

a generally cylindrical body having an inner surface and an outer surface, said body including a flexible matrix and a plurality of carbon fibers embedded within said flexible matrix, said carbon fibers arranged helically and positioned at an angle with respect to the longitudinal axis of said body, wherein said body being capable of expanding and returning to an original form.

2. The inflatable heating device of claim 1 wherein said flexible matrix comprises fluorosilicone.

3. The inflatable heating device of claim 1 wherein said flexible matrix comprises fluorocarbon.

4. The inflatable heating device of claim 1 wherein said carbon fibers are arranged at an angle of ±45° with respect to said longitudinal axis of said body.

5. The inflatable heating device of claim 4 wherein said carbon fibers are arranged in one of tows and bundles to provide approximately 50-90% coverage of said body.

6. The inflatable heating device of claim 1 wherein said carbon fibers are in the form of a non-woven tape.

7. A process of forming an inflatable heating device comprising the steps of

applying a layer of uncured sheets of a fluorosilicone material to a mandrel;

winding a plurality of carbon fibers in a helix onto said fluorosilicone material layer;

applying a layer of uncured sheets of fluorocarbon material over said carbon fibers;

applying a radially inward pressure to said fluorosilicone layer, carbon fibers and fluorocarbon layer; and

applying an electric current to said carbon fibers to resistively heat said carbon fibers to cure said fluorosilicone layer and said fluorocarbon layer to form a cured structure.

8. The process of claim 7 further comprising the steps of

removing said electric current from said carbon fibers;

removing said radially inward pressure from said fluorosilicone layer, carbon fibers and fluorocarbon layer;

allowing said cured structure to cool; and

removing said cured structure from said mandrel.

9. The process of claim 7 wherein said applying an electric current step comprises resistively heating said carbon fibers to heat said fluorosilicone layer and said fluorocarbon layer to a temperature of approximately 300°F for approximately 45 minutes.

10. The process of claim 9 further comprising removing said fluorosilicone layer, carbon fibers and fluorocarbon layer from said mandrel, and heating said fluorosilicone layer, carbon fibers and fluorocarbon layer to a temperature greater than 300°F.

11. The process of claim 7 further comprising incorporating a layer of uncured silicon sheets in said cured structure.

12. An apparatus for curing a pre-preg repair material supporting a heat curable resin for in-situ repair of a conduit, comprising:

an elastomeric composite having a first end and a second end, wherein the composite includes a non-ferrous heating element disposed within a thermoset resin matrix;

a first end piece fixedly attached to the first end of the composite and having an air port for communication with a compressed air source, a vacuum port for communication with a vacuum supply source and at least one electrical cable port for communication with a power supply source; and,

a second end piece fixedly attached to the second end of the composite, wherein

the composite, the first end piece, and the second end piece form an inflation chamber.

13. The apparatus of Claim 12 wherein the thermoset resin is selected from the group consisting of fluorocarbon and fluorosilicone.

14. The apparatus of Claim 12 wherein the heating element includes a plurality of braided fibers comprising of temperature tolerant fiber braids and electrically conductive fiber braids.

15. The apparatus of Claim 14 wherein the braided fibers interact to define a braid angle measure at +/- 45 degrees.

16. The apparatus of Claim 14 wherein the electrically conductive fiber braids are carbon filaments.

17. The apparatus of Claim 12 further including a pre-preg removably attached to an outer surface of the composite and including a structural fiber matrix supporting a heat curable resin.

18. The apparatus of Claim 12 wherein the heating element includes a plurality of wound fibers comprising of temperature tolerant fiber windings and electrically conductive fiber windings.

19. The apparatus of Claim 18 wherein the wound fibers interact to define and angle measure at +/- 45 degrees.

20. A method for repairing a damaged section of a conduit comprising the steps of:

providing an elastomeric composite having a first and second end, wherein the composite includes a heating element disposed within a thermoset resin matrix;

fixedly attaching a first and second end piece respectively to the first and second ends of the composite, wherein the first end piece, the second end piece, and the composite form a heating/inflation module;

removably attaching a pre-preg to an outer surface of the composite, wherein the pre-preg includes a structural fiber matrix supporting a heat curable resin;

positioning the module with the attached pre-preg into the conduit at a damaged location;

inflating the module to a predetermined internal air pressure to expand the composite and press the pre-preg against an inside surface of the conduit;

curing the resin of the pre-preg by causing an electrical current to flow in the heating element to resistively heat the module to a predetermined temperature; and

deflating the module and removing it from the conduit.

add a10
add B3